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SUPERFICIAL *VERSUS* COMBINED (DEEP AND SUPERFICIAL) CERVICAL PLEXUS BLOCK FOR CAROTID ENDARTERECTOMY

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SUMMARY – It is not clear if any technique of regional anesthesia for carotid endarterectomy has an advantage over another. Therefore, we analyzed analgesic efficacy, side effects and complication rate in patients undergoing carotid surgery either under combined (deep and superficial) or superficial cervical block alone. Data on 324 patients that received either combined (n=107) or superficial (n=216) cervical block were prospectively analyzed. Data were collected on the intraoperative Verbal Analog Score (VAS), arterial pressure and heart rate. Analgesic efficacy was additionally assessed by the dose of supplemental 1% lidocaine and fentanyl and time before the first analgesic was administered at Intensive Care Unit. During surgery, VAS was slightly higher in the superficial group (median 0.6, range 0-3.9) than in the combined group (median 0.4, range 0-2.4; $p<0.001$). The median supplemental lidocaine dose during the operation was higher in the superficial block group (2.4 mg/kg, range 1.1-3.5) than in the combined group (2.1, range 0.5-3.4 mg/kg; $p<0.001$). Supplemental fentanyl was also higher in the superficial block group. There were no between-group differences in the time before the first postoperative analgesic, postoperative VAS and block-related complication rate. Accordingly, combined block provided a slightly better analgesia during the surgery, which was probably clinically irrelevant. There was no difference in postoperative analgesia and hemodynamic stability. So far, this is the largest prospective study in which superficial cervical block was found to be as efficacious as combined block which is associated with a considerably higher risk of complications.

Key words: *Anesthesia, conduction – methods; Endarterectomy, carotid – methods; Endarterectomy, carotid – adverse effects; Nerve block – adverse effects*

Introduction

Carotid endarterectomy (CEA) has been performed under general or regional anesthesia. There is still no definite statement that one technique has an advantage over the other[1-3]. A large prospective randomized study compared general and regional anesthesia for CEA[4]. Deep, superficial and combined (deep and superficial) cervical blocks are the most frequently used regional techniques for C2-4 cervical nerve blockade required for CEA. In contrast to superficial block alone, which is considered a low risk procedure[5], deep and combined (deep and superficial) cervical blocks are associated with potentially serious complications. Vertebral artery puncture, epidural and subarachnoid injection[6] and respiratory insufficiency due to phrenic nerve block are the possible complications associated with deep cervical block[7,8]. On the other hand, there is no evidence that either deep or combined cervical block is superior to the superficial one. A few studies that compared different types of regional anesthesia produced conflicting

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results. Davies *et al*.[5] imply that combined block produces a more complete block than superficial block alone. Stoneham *et al*.[9] analyzed efficacy and side effects of superficial and deep cervical blocks and found no clinically relevant difference. Pandit *et al*.[10] compared superficial and combined (deep and superficial) blocks and found no difference either. So, two studies comparing superficial and combined block, i.e. the one conducted by Davis *et al*.[5] and the other by Pandit *et al*.[10], yielded conflicting results. As combined block carries a considerably greater risk of technical complications, it is clinically relevant to find out whether it has any advantages over superficial block alone. The aim of our prospective observational study was to investigate, in a large patient sample, whether there was any relevant difference between superficial and combined cervical block for CEA.

Patients and Methods

Data were prospectively recorded into a form designed for the study. A total of 324 consecutive patients scheduled for CEA from October 2002 to December 2004 were included. Of these, 217 (67%) patients were operated under superficial cervical block and 107 (33%) under combined cervical block.

Patients were assigned to practitioners by an essentially random administrative process. Each practitioner had a preferred technique, which was applied independently of the patient involved. The difference in the number of patients between the groups (217 in superficial and 107 in combined group) reflected predetermined conditions; considering the relatively large number of patients in both groups, we believe it did not cause any bias in study results.

Two 16-gauge IV cannulas and a 20-gauge arterial cannula for invasive blood pressure monitoring were inserted in the contralateral arm. Noninvasive blood pressure, five-lead ECG and pulse oxymetry had been commenced before the block was performed. Blood pressure and heart rate were recorded every 5 minutes. All patients received premedication with midazolam 3-5 mg intramuscularly. Propofol infusion was administered in all patients and titrated until they were calm and cooperative. The mean propofol infusion rate was 0.75±0.39 (range 0.23-2.98) mg/kg/h.

Superficial cervical block was performed using the standard technique[6]: 30 mL of local anesthetic was injected fan-like along the posterior border of the sternocleidomastoid muscle. Deep cervical block was achieved by identification of transverse process of C2, C3, C4 or only C3 and C4. Local anesthetic was injected in slightly caudal direction. All patients received 5 mL submandibular infiltration of local anesthetic. The anesthetic mixture consisted of 0.5 bupivacaine and 2% lidocaine with epinephrine 1:200 000. Small variations in the anesthetic dose and volume arose from differences in patient body mass. The median bupivacaine dose was 1.92 mg/kg (range 1.33-2.5 mg/kg) in the superficial block group and 1.97 mg/kg (1.6-3 mg/kg) in the combined block group. The median lidocaine dose was 2.1 mg/kg (range 0.5-3.4 mg/kg) in the superficial block group and 2.4 mg/kg (range 1.1-3.5 mg/kg) in the combined block group.

Table 1. Patient data

	Superficial cervical block N=216 (66.9%)			Combined cervical block N=107 (33.1%)			
	Median	Minimum	Maximum	Median	Minimum	Maximum	p
Age (yrs)	68.0	45.0	99.0	69.0	40.0	86.0	0.723*
Weight (kg)	77.5	48.0	138.0	78.0	48.0	110.0	0.320**

	Superficial cervical block N=216 (66.9%)		Combined cervical block N=107 (33.1%)		
	n	%	n	%	
Gender (male)	140	64.6	70	65.6	0.902***
ASA grade II	113	53.7	51	47.6	0.408***
ASA grade III	104	48	56	52.4	0.479***

*Mann-Whitney test; **t-test for independent samples; ***χ^2-test

Table 2. Analgesic efficacy of superficial and combined cervical block assessed by Verbal Analog Score (VAS), supplemental analgesics and time to first analgesic dose (metamizole 2.5 mg) at Intensive Care Unit

	Superficial cervical block N=216 (66.9%)			Combined cervical block N=107 (33.1%)			
	Median	Minimum	Maximum	Median	Minimum	Maximum	p*
Intraoperative VAS	0.5	0	3.0	0.3	0	2.1	<0.001
Supplemental 1% lidocaine (mL)	5.0	0	40.0	3.0	0	40.0	0.003
Supplemental fentanyl (mg)	50.0	0	180.0	50.0	0	100.0	
Postoperative VAS	0.6	0	3.5	0.4	0	2.4	0.411
First postoperative analgesic (h)	4.0	1	15	6	1	20	0.124

*Mann-Whitney test

Analgesic efficacy was assessed using Verbal Analog Score (VAS) of 11 points (0-10) which was explained to patients before surgery. VAS was taken every five minutes. Additional intravenous opioid or local anesthetic was administered when VAS was over three points. Infiltration of 1% lidocaine by a surgeon and supplemental intravenous fentanyl were additional criteria for analgesic efficacy of cervical block.

Statistics

Numerical data were described by mean, standard deviation (SD), median and range (maximum-minimum). All numerical data were tested for normal distribution by Kolmogorov-Smirnov test. Differences between mean values for normally distributed variables were compared by Student's t-test. Variables which were not normally distributed or variables without homogeneous variance were compared by nonparametric Mann-Whitney test. Qualitative data were compared by χ^2-test or Fisher exact test where appropriate. Correlation between two variables was determined using Spearman's rank correlation test. For data analysis the commercial Statistica 6 software was used.

Results

Patient age, gender, weight and ASA (American Society of Anestesiologists) grade were similar in both groups. All patients underwent CEA successfully under regional anesthesia and none needed introduction of general anesthesia. When asked, surgeons were unable to distinguish which type of cervical block was used. (Tables 1and 2).

Both techniques showed high analgesic efficacy. Median values in both groups were well beyond three points (0.3 in combined group and 0.5 in superficial block group), which is considered as a clinical indication for

Table 3. Hemodynamic variables in patients under superficial and combined cervical block

	Superficial cervical block N=216 (66.9%)		Combined cervical block N=107 (33.1%)		
	Mean	Standard deviation	Mean	Standard deviation	p*
Systolic blood pressure (mm Hg)	159.7	18.81271	159.8	15.04711	0.977
Dyastolic blood pressure (mm Hg)	75.7	10.47967	74.4	12.50530	0.404
Mean blood pressure (mm Hg)	103.4	11.48685	102.3	11.53843	0.509
Heart rate (beats/min)	83.0	14.92695	88.0	18.04992	0.023

*t-test for independent samples

Table 4. Block related complications

	Superficial cervical block N=217		Combined cervical block N=107		p*
General intraoperative	n	%	n	%	
Conversion to general anesthesia (block failure)	0	0.0	0	0.0	1.000
Convulsions	1	0.6	0	0.0	0.671
Dysrhythmia	0	0.0	1	1.2	0.332
Coronary ischemia	1	0.4	0	0.0	0.670
Restlessness	3	1.7	1	1.2	0.599
Local intraoperative					
Hematoma formation	0	0.0	0	0.0	1.000
Recurrent nerve paresis	40	22.6	23	27	0.662
Brachial plexus paresis	1	0.4	0	0	0.670

* Fisher exact test

additional analgesic administration. However, there was a statistically significant between-group difference in intraoperative VAS and supplemental fentanyl and lidocaine. The group under combined block had lower mean VAS and received less supplemental fentanyl and lidocaine. There was no between-group difference in postoperative analgesic efficacy (Table 3).

Analyzing all hemodynamic data, a statistically significant difference was only found in heart rate. Patients under combined block had a slightly higher heart rate (88/min) than those in superficial block (83/min). It was probably caused by a more profound vagus nerve block in the combined block group (Table 4).

Complication rate was low, apart from relatively frequent dysphonia (24%) due to transitory block of recurrent nerve. The incidence of this complication exceeded literature reports[11], however, it resolved in all patients during the first postoperative day. There was no significant difference in any type of complication between the two groups (Table 5).

Discussion

The main result of our study is that superficial and combined (deep and superficial) cervical blocks were both effective and safe techniques for carotid endarterectomy, however, the latter provided slightly better analgesia during surgery. The slight difference in the intraoperative analgesic efficacy is in contradiction with recent studies[10,12], which found both techniques equally effective. In their prospective randomized study in 40 patients, Pandit *et al.*[10] found no difference in analgesic efficacy between the two techniques. De Sousa *et al.*[12] confirmed these results in a larger group of 120 patients. In our study, the difference in analgesic efficacy between the two patient groups was probably detected due to the study design that included frequent assessment of analgesia by VAS and a substantially greater number of patients. Interestingly, Davies *et al.*[5] included a significantly greater number of patients in their study than the other two recent studies[6,9], and also suggest that combined block might offer a more complete block than superficial block alone. Nevertheless, the median VAS of 0.5 point in the superficial block group and 0.3 in the combined block group was highly satisfactory. Therefore, the slight difference in analgesic efficacy between the two techniques was probably of no clinical relevance. The high efficacy of superficial cervical block could be explained by findings reported by Pandit *et al.*[13]. They conducted a study on cadavers, in which dye penetration was found in deeper cervical structures than originally assumed.

Our study differed in some aspects from the study carried out by Pandit *et al.*[10]. The total dose of bupivacaine was higher (2 mg/kg in the combined block group and 1.9 mg/kg in the superficial cervical block group) than that used in their study, where the mean dose was 1.4 m/kg. We also used lidocaine in combination with bupivacaine in order to enhance analgesic efficacy. In spite of high local anesthetic doses, we recorded only two (0.8%) cases of dysrhythmia, which could have possibly been attributed to local anesthetic or epinephrine

supplementation. As a consequence of a higher local anesthetic dose and fentanyl administration, less lidocaine supplementation by the surgeon was needed. The median 1% lidocaine supplementation dose was 30 mg (range 0-400 mg) in patients under combined cervical block and 50 mg (range 0-400 mg) in patients under superficial block alone. In the study by Pandit *et al*.[10], lidocaine supplement dose was 100 mg in the superficial and 115 mg in the combined block group.

The possible limitation of our study was the fact that it was a prospective observational study in contrast to the two previous studies[9,10], designed as controlled prospective randomized studies. On the other hand, the substantially larger number of patients and frequent assessment of intraoperative analgesia in our study made it possible to detect a slight difference in the intraoperative analgesic efficacy between the two patient groups.

In conclusion, our study revealed the combined block method to provide slightly better surgical analgesia than superficial block alone. However, the difference was small (0.5 VAS in the superficial group *vs* 0.3 in the combined group) and probably beyond any clinical significance. So, our study performed in a substantially greater number of patients than the one conducted by Pandit *et al*.[10] confirmed that combined block did not offer any clinically relevant advantage over superficial block.

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Sažetak

POVRŠINSKI PREMA KOMBINIRANOM (DUBOKOM I POVRŠINSKOM) BLOKU VRATNOG PLEKSUSA ZA KAROTIDNU ENDARTEREKTOMIJU: PROSPEKTIVNA STUDIJA U 324 BOLESNIKA

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Zasad još nije jasno ima li ijedna tehnika regionalne anestezije za karotidnu endarterektomiju prednosti pred drugima. Stoga smo analizirali djelotvornost analgezije, nuspojave i stopu komplikacija kod bolesnika podvrgnutih operaciji karotide pod kombiniranom (dubokom i površinskom) ili samo površinskom blokadom vratnog pleksusa. Prospektivno smo analizirali podatke za 324 bolesnika koji su primili kombinirani (n=107) ili površinski (n=216) blok vratnog pleksusa. Prikupljeni su podaci za intraoperacijsku vrijednost VAS (*Verbal Analog Score*), arterijski tlak i srčanu frekvenciju. Djelotvornost analgezije dodatno se procjenjivala prema dozi dopunskog 1%-tnog lidokaina i fentanila te vremenu proteklom do prvog davanja analgetika u Jedinici intenzivne skrbi. Za vrijeme operacije je VAS bio nešto viši u skupini s površinskom blokadom (medijan 0,6, raspon 0-3,9) u odnosu na skupinu s kombiniranom blokadom (medijan 0,4, raspon 0-2,4; p<0,001). Medijan doze dopunskog lidokaina tijekom operacije bio je viši u skupini s površinskom blokadom (2,4 mg/kg, raspon 1,1-3,5 mg/kg) negoli u skupini s kombiniranom blokadom (2,1 mg/kg, raspon 0,5-3,4 mg/kg; p<0,001). Doza dopunskog fentanila bila je također viša u skupini s površinskom blokadom. Nije bilo razlike među skupinama u vremenu do prvog poslijeoperacijskog analgetika, poslijeoperacijskoj vrijednosti VAS i stopi komplikacija povezanih s blokadom. Zaključeno je kako kombinirana blokada osigurava nešto bolju analgeziju tijekom operacijskog zahvata, no razlika je vjerojatno klinički nevažna. Nije bilo razlike u poslijeoperacijskoj analgeziji i hemodinamskoj stabilnosti. Dosad je ovo najveća prospektivna studija u kojoj je utvrđeno da je površinska blokada vratnog pleksusa jednako djelotvorna kao kombinirana blokada, koja je udružena sa znatno većim rizikom od komplikacija.

Ključne riječi: *Anestezija, provedba – metode; Endarterektomija, karotida – metode; Endarterektomija, karotida – štetni učinci; Blokada živca – štetni učinci*